

To: Montana GIS Conference Participants

From: The Montana Interagency GIS Technical Working Group

Subject: *Montana GIS Standards Plan*

A draft of the *Montana GIS Standards Plan* was recently completed by the Montana Interagency GIS Technical Working Group (TWG). The aim of the plan is to provide a standard for cooperation and data sharing among current GIS users as well as to provide guidance to those organizations considering developing a GIS.

The TWG has provided copies of the draft plan to conference participants so that comments and additional information from the GIS community could be included in the plan. Please take some time to review the Draft *Montana GIS Standards Plan* and answer the questionnaire below. If you would like to make specific revisions, please feel free to make those on the appropriate pages and return those pages along with the questionnaire. Also, please feel free to pass along comments to or ask questions of any of the TWG members involved in preparing the *Plan*.

Please leave the completed questionnaire at the conference registration desk or send it to:

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1. Does the plan adequately address accuracy issues?

2. Are the guidelines in the plan easy to understand and follow?

**Montana
Geographic Information System
Standards Plan**

D R A F T

Prepared by

**The Montana GIS Interagency
Technical Working Group**

November 21, 1991

EXECUTIVE SUMMARY

This plan was developed by the Montana GIS Interagency Technical Working Group (TWG) as directed by a Memorandum of Understanding concerning interagency coordination and support for Geographic Information Systems (GIS) in Montana. Goals of the TWG are to minimize the duplication of digital data, transfer technology, exchange data, develop data standards, and to share resources in completing joint, interagency projects. This plan was developed to foster development, use, and sharing of high quality GIS data and to promote cooperation among the various federal, state, and local governmental agencies involved with GIS.

A baseline yardstick is necessary to gauge quality and applicability of GIS data. This plan provides that benchmark. Standards add rigor and consistency to collecting, creating, and maintaining spatial data and they benefit the whole GIS user community by providing for compatibility and exchange. Data standard objectives include defining: acceptable source materials, guidelines for manual and automated digital capture of spatial information, levels of accuracy and acceptable levels of data documentation. Data transfer methods and protocol are described in addition to data documentation guidelines and identification of state-wide base data layers. Ethical considerations are addressed; do it well, do it right, do it professionally.

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PREFACE

The *Montana Geographic Information System Standards Plan* is a product of the Montana GIS Interagency Technical Working Group (TWG). The TWG was organized to "coordinate the development of geographic information systems (GIS) in Montana." The agencies and their representatives responsible for the development of this plan are:

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Disclaimer

Any mention or use of trade names, computer hardware, computer software, or commercial products does not constitute recommendation for use or endorsement.

CHAPTER 1 -- INTRODUCTION

- 1 The *Montana Geographic Information System Standards Plan* was developed to provide a standard for cooperation among the various federal, state, and local governmental agencies involved with geographic information systems (GIS). The overall goals of the *Plan* are to foster cooperation among the various entities using GIS and to provide guidance to those agencies contemplating starting a GIS. Specifically, the *Plan* provides direction to implement the goals of the *Montana Interagency GIS Memorandum of Understanding* (see *Appendix A*) which has as its objectives:
 - To establish a cooperative effort to share digital data among the various resource management agencies and organizations within the state.
 - To make available all relevant, public domain, digitized databases managed by participating agencies.
 - To develop priorities for joint GIS development efforts and projects.
 - To investigate opportunities to jointly fund projects designed to create statewide, base map themes for Montana.
 - To develop and share new and emerging technologies to facilitate GIS products.
 - To promote the use of GIS by resource managers, scientists, educators, and where appropriate, the general public.

The development and implementation of this plan is conducted under the authority of the Memorandum of Understanding which established the Montana GIS Interagency Management Steering Committee and the Montana GIS Interagency Technical Working Group (TWG). The TWG will review this plan on a regular basis and make revisions and updates as required.

CHAPTER 2 -- PROJECT AND DATA COORDINATION

- 2 Recognizing that there is no one agency in Montana mandated with the creation and storage of state-wide GIS data themes, or the coordination of GIS activities, there is a need to coordinate agencies and data, to document the usability of the data, coordinate the sharing of those data themes, and coordinate GIS projects and activities.

2.1 ROLE OF THE GIS TWG

The Montana GIS Interagency Technical Working Group will act as a forum for the exchange of information regarding the acquisition of new GIS data, the existence of current GIS data, and information relating to agency GIS projects. As stated in the *Memorandum of Understanding* (Appendix A), a goal of the TWG is to encourage "agencies to minimize the duplication of digital data, transfer technology and exchange data, develop data standards, and share resources in completing joint, interagency projects."

As part of its data coordination effort, the TWG will maintain a permanent meeting agenda item dedicated to data acquisition. Time will be set aside at each TWG meeting for the participating agencies to present data acquisition plans.

2.2 ROLE OF THE STATE MAPPING ADVISORY COMMITTEE

The State Mapping Advisory Committee (SMAC) is charged with developing and submitting the state's cartographic requirements to the National Mapping Program of the U.S. Geological Survey. The SMAC meets once a year to develop mapping priorities for the USGS per the A-16 Process. In Montana, both state and federal representatives attend the SMAC meeting. Only state representatives may vote on priorities. However, most of the mapping requests are coordinated with the federal representatives to more effectively use the A-16 process and to avoid duplication of mapping requests.

2.3 ROLE OF THE GIS USER GROUP

The Montana GIS User Group is a state-wide consortium of governmental agencies and businesses involved with GIS technology. At the 1990 Montana GIS Conference in Missoula, Montana, the User Group adopted a founding charter.

The Group's purpose is to provide a forum for exchanging information and ideas on GIS technology. Membership is open to anyone with an interest in GIS and willing to share their knowledge. The User Group sponsors an annual GIS conference and a quarterly newsletter (see below) and support other activities (e.g., the *Montana Data Directory*) designed to transfer information on GIS in Montana. Another responsibility of the Group is to offer input to the Montana Interagency Steering Committee and its Technical Working Group.

The Group resolves to be a non-profit organization; any funds generated by Group activities are fully invested in projects that serve the GIS community at large in Montana. There are no membership dues. At the annual meeting, members approve goals and an agenda for the subsequent year.

2.3.1 Montana GIS Conference

The Montana User Group sponsors an annual GIS conference. The conference is hosted by a different agency and held in a different location each year. NRIS provides administrative support to the conference planning committee.

2.3.2 Montana GIS News

The *Montana GIS News* is a quarterly newsletter published by the Natural Resource Information System for the Montana GIS User Group. The newsletter is designed to facilitate the transfer of information of GIS data, activities, and projects in Montana. GIS User Group are encouraged to submit articles for the newsletter.

2.4 ROLE OF THE NATURAL RESOURCE INFORMATION SYSTEM

In 1985, the Montana Legislature created the Natural Resource Information System (NRIS) "... to provide a ready, accessible means of finding information on Montana's natural resources." NRIS, located at the Montana State Library in Helena, operates as a data clearinghouse and referral service to link users with the best sources of information. In addition, NRIS coordinates among agencies and organizations that collect, manage, or use the same types of natural resource information in order to prevent duplication of effort and to promote information sharing. NRIS has expanded this effort to include the inventory of non-natural resource GIS related data.

2.5 DATA REPOSITORIES

There is no official GIS data repository for Montana. NRIS was not established to be a data repository. NRIS believes that data are most appropriately housed and distributed by the collecting agency. However, NRIS will house data that are in the best interest of the State of Montana that no other agency can store and distribute. In addition, NRIS will work with agencies to coordinate data sharing. For example, NRIS will maintain the *Montana Data Directory*, perform data searches, assist in obtaining data, and assist in distributing data.

2.6 NRIS DATA DISTRIBUTION POLICIES

The Natural Resource Information System is mandated by the Montana State Library Laws (MCA 90-15-304) to "(1) Except as provided in subsection (3), the library shall make information from the natural resource information system available to local, state, and federal agencies and to the general public. (2) The library may establish a fee system for information requests in order to cover the costs of providing requested information. (3) If necessary, the library shall establish procedures to protect confidential information in the possession of state agencies." NRIS will take necessary steps to identify provisional data which would impose limitations on the appropriate uses of the data. Stated simply, NRIS information distribution policy is: *NRIS will distribute data and information to any and all organizations or individuals who request it. In addition, based on the library code of ethics and library policy, NRIS may not disclose, without permission, the identity of individuals or organizations requesting data.*

CHAPTER 3 -- DATA STANDARDS

- 3 The key to developing uniform statewide GIS databases to be shared by a variety of users is the introduction of comprehensive digital spatial data standards. These standards should cover procedures for the design, development, and maintenance of GIS databases. For the individual GIS user, standards add rigor and consistency to the process of collecting, creating, and maintaining spatial data. Standards benefit the whole GIS users community in Montana and elsewhere by providing for compatibility and exchange of spatial data.

3.1 CONCEPTUAL OVERVIEW

The focus of these standards is to provide guidance as to the accuracies, techniques, contents, and formats required to develop compatible digital spatial data. This document establishes minimum, but adequate standards designed to enable flexibility for individual user needs, and yet produce a high quality data product usable by others. If the user correctly and consistently follows these guidelines, the Montana GIS Digital Map Standards (quality control criteria) should be met without difficulty. Standards for accuracy of spatial data are based largely on the United States National Map Accuracy Standards. See Appendix B.

All parties considering the use of existing digital data are responsible for evaluating the suitability and reliability of the data for their own applications. In other words, the creator or distributor of the data is not responsible for misapplication of the data by subsequent users.

These standards apply to data captured using current, commonly available technology, including hardware and software. They will be revised as necessary to meet future technology advances.

Since these standards do not address hardware or software issues, it is the individual's job to select appropriately for their GIS needs. In selecting software, it should be recognized that the Montana GIS Technical Working Group recommends the USGS Digital Line Graph (DLG-3 Optional) format for GIS data exchange in the absence of direct software conversion capability. For data exchange with CAD users, the Digital Exchange Format (DXF) is recommended. Data exchange is addressed in Chapter 3 of this document.

3.2 GOAL

The goal of these standards and procedures is to promote compatibility of digital spatial data within the GIS users community.

3.3 OBJECTIVES

The objectives of these standards are:

1. To define acceptable source materials.
2. To provide guidelines for manual and automated digital capture of spatial information. This includes both thematic and base data as defined in the Data Coordination section.
3. To identify the level of accuracy for digital spatial data which are to be shared.
4. To establish an acceptable level of data documentation.

5. To facilitate the cataloguing of digital spatial data created by state and federal agencies and others in the *Montana Data Directory*.

3.4 GENERAL GUIDELINES

The following guidelines cover areas not specifically addressed in other sections of this document.

3.4.1 Communication

The planned acquisition of digital cartographic systems or geographic information systems, and the collection of data by local, state, and federal agencies should be reported to the Montana Interagency GIS Technical Working Group. This report will be a permanent agenda item for TWG meetings. In addition, the planned acquisition of data will be entered into the "Project" database of the *Montana Data Directory* and reported in the *Montana GIS News* as part of the TWG minutes. This communication among GIS coordinators benefits all users by preventing duplication of effort.

3.4.2 Statewide Standard Scale

For GIS projects, the TWG encourages the use of accepted scales for the collection and storage of digital spatial data. Accepted scales are: 1:1,000,000, 1:500,000, 1:250,000, 1:100,000, 1:62,500, and 1:24,000. The TWG recognizes that it cannot always direct the scale of site specific, statewide, or national mapping/digitizing projects. However, if an agency is given a choice in compilation scale, the TWG recommends the USGS 1°x ½° degree (1:100,000) quadrangle series as the standard compilation tile and scale for **statewide** theme development. The 1:100,000 scale level balances the economic and accuracy considerations of regional data development for most planning and natural resource activities. The 7.5' series should be used for detailed studies or for local planning. Base and/or theme data from smaller scales or other data sources may be considered for inclusion in Montana's digital database, but decisions regarding map scale will be carefully judged relative to the availability of needed data and the quality of the proposed map.

3.5 SOURCE MEDIA GUIDELINES

3.5.1 General

- Compiled on stable materials (e.g., mylar). Materials, from most to least desirable are:
 - (1) mylar original;
 - (2) mylar contact reproduction; and,
 - (3) vellum or paper with an accurate mylar registration overlay.
- Provide at least 8 registration tics (unless limited by software). The tics must be known locations drafted on a map.
- Linework clear and of consistent width, .01" is most desirable.
- Clear notation of the map's theme, series (if any), scale, datum, projection, zone, date, and compiler and/or agency.
- Source maps to be digitized must not be folded; ideally they should be kept in flat files.

- Photographic bases must be planimetrically rectified (orthophotos).

3.5.2 National Map Accuracy Standards

Source map compilation should meet the National Map Accuracy Standards (NMAS). These standards are referenced in *Appendix B: United States National Map Accuracy Standards*. Some examples of horizontal accuracy are:

Map Scale	NMAS Horizontal Accuracy	Allowable Error	
		Inches	Feet
1:12,000	12,000/30	400	33
1:24,000	24,000/50	480	40
1:100,000	100,000/50	2,000	166

- Source maps prepared under National Map Accuracy Standards (NMAS) carry a statement to that effect.

3.5.3 Materials for Scanning

- Compile only one theme per overlay (unless software enables digital theme separation by line type/pattern.)
- Compile attributes on a separate overlay. Save time and materials by placing attribute information on a paper photocopy of the completed linework.
- Linework of clear and consistent width, .01" is most desirable. Use a straightedge for delineating straight features. Line junctions should be clear without over/undershoots.
- Include notation of scale, quad name or other title, content, north arrow, tic coordinates, projection, date, contact person and phone number.
- Be aware of scanner size limitations.
- Perform a thorough check for (1) complete and accurate duplication of the source and (2) correct edge matching of both line work and attributes.
- If the materials will be scanned off-site, keep copies.
- Materials should be clean and smudge-free before scanning.

3.6 DIGITIZING GUIDELINES

3.6.1 Content Consistency

- Standard data capture units or tiles are 7.5', 15', 30', 1°x ½° degree, and 1°x 2° degree quadrangles.

- Complete base or theme feature categories over the entire quad unit; partial quads are not desirable. Exception: thematic data compilations may include "no data" areas which do not contain any features to be digitized.

3.6.2 Positional Accuracy

- Data capture will occur in the same projection and zone as the source graphic.
- Register a minimum of 8 tics (unless limited by software). The tics must be known locations drafted on a map.
- Re-register the source graphic after a major time-break.
- The maximum acceptable Root Mean Square Errors (RMSE) for registration of the source graphic is .003 digitizer inches. The maximum acceptable RMSE in map units are as follows:

Map Scale	RMSE Ground Meters	Ground Feet
1:240	0.018	0.060
1:4,800	0.366	1.20
1:12,000	0.914	3.00
1:20,000	1.52	5.00
1:24,000	1.83	6.00
1:62,500	4.76	15.6
1:100,000	7.62	25.0
1:250,000	19.1	62.5
1:500,000	38.1	125
1:1,000,000	76.2	250

Example: If 1" on digitizer = 24,000" on 1:24,000 map,
 then .003" on digitizer = 24,000 x .003 = 72" on map;
 $72 / 12 = 6.00$ feet on map;
 $6.00' / 3.281 = 1.829$ meters on map.

- Collect adequate points to represent line and polygon features. That is, so that plotted digitized features will lie within .01" (.25mm) of the source map features.
- Coincident features are not to be digitized twice. If a data theme shares common lines with another theme, the common features should be copied from one into the other, not re-digitized. To ensure exact coincidence of common boundaries (state, counties, lake and river shores, etc) when they form part of a data theme, obtain the endorsed base boundary layer. The correct layer can be identified through the Natural Resource Information System or the *Montana Data Directory*. Use this layer as a template and digitize your data theme to that boundary.

- Spatial data will have connectivity where all polygons intended to be closed will be closed, e.g. in counties where part of boundary is shared with a hydrographic feature, close the polygon with the hydro feature boundary. Also, some software will allow incomplete digital polygon closure; this is not acceptable -- all polygons must be closed.

3.6.3 Elevational Accuracy

Elevational accuracy is assessed by selecting at least twenty known elevation points on the original map source and comparing these locations to the corresponding locations on the digital product. USGS topographic maps have several vertical control points on each map that should be used as known elevation points for this test. Ninety percent of the test points must meet the following specifications:

- 7.5-Minute Tile: Elevation accuracy will meet one of three accuracy levels, depending on source map accuracy and techniques used for digitizing or scanning/processing.

Level One - accurate within 1 contour interval

Level Two - accurate within 1/2 contour interval

Level Three - accurate within 1/3 contour interval

USGS Digital Elevation Model (DEM) data are Level Two data or better in their original form. The data should be checked after it has been incorporated into a GIS to verify it has maintained its accuracy level.

- 15-Minute and 30-Minute Tiles: Test points within one-half contour interval.

3.6.4 Attribute Accuracy

- Definition of Terms:

To assign "attributes" means to identify map objects, using either the original map text or a code, which can link an object to attribute tables.

A "code" is an alias character string (numeric, alpha, or alpha-numeric) which refers to the original map feature name and can also link an object to attribute tables.

A "label" is an object's unique number (1 to n) within a map coverage.

- If map objects are to be assigned attributes,
 - (1) all similar map objects should be assigned attributes (i.e. no omissions),
 - (2) attributes should be assigned correctly with reference to the source, and,
 - (3) no duplicate attributes should exist on a single object
- Coding schemes will be consistent
- A look-up table will be provided which indicates code-to-original name associations.

3.6.5 Derived Data

- Do not merge data from two differing scales unless absolutely necessary.
- Document the source data used and specify the derived data scale as being the smallest of the input maps.

3.6.6 Automated Digitizing (Scanning) Guidelines

- Register a minimum of 4 ticks
- Minimum density of 200 pixels per inch (?)

3.7 MONTANA GIS DIGITAL MAP STANDARDS

- For each digital map unit or tile (e.g. quad) a proof plot should be made to verify accuracy standards described below.
- Line representation on a same-scale, stable check plot is within .01" (.25mm) of original lines regardless of scale.
- Digital data will be topologically "clean" and free of errors such as overshoots, slivers/gaps, open polygons (undershoots), or unresolved line segment intersections.
- Edge match tolerance is .01"
- Attributes are complete and correctly assigned.
- No "unknown" or blank areas unless specified as such on the source map.
- Ninety percent of the digitized map features will be within .01" of the feature on the source map, measured from the center of the line or point. To check this, the data gathering party will randomly select at least 20 points on either the source or the check plot. Ninety percent of the test points must meet the .01" standard.
- Scanned data must meet all of the above standards.
- Coincident objects in two different coverages (i.e. county boundaries or lake shores) must overlay exactly.
- Elevation data will meet USGS standards as noted in *Appendix B*.

CHAPTER 4 -- TRANSFER METHODS

- 4 The implementation of data transfer standards are intended to provide efficient exchange of data between users. Once it has been established that data are available for a project, the following steps should be undertaken. These transfer methods are intended as guidelines. The TWG recognizes individual agencies requirements that may take precedence over these guidelines.

4.1 DATA REQUEST

A letter of request should be sent providing details as to:

- what data are requested;
- why the data are needed;
- how will the data be used;
- the audience the output will attract; and,
- the data format necessary to achieve the transfer.

The party requesting information is responsible for making conversions and providing media. The sending party will provide documentation for the data.

4.2 DOCUMENTATION

Data documentation should be supplied with the following:

- Format: USGS Digital Line Graph, DLG-3 optimal format for universal data exchange or Digital Exchange Format (DXF) is recommended as the standard transfer method;
- Projection: include relevant characteristics of the projection used;
- Units of measure;
- Resolution;
- Transfer date;
- Attribute Information: as it relates to the transfer of data; and,
- Transfer media format and other specifics.

4.3 DATA CONVERSION PROCEDURES

The Natural Resource Information System will keep on file data conversion procedures and tips. Selected procedures and helpful information will be published in the *Montana GIS News*. See Appendix C for a data conversion format reference.

CHAPTER 5 -- DATA DOCUMENTATION

- 5 GIS data documentation provides information about the history and format of digital map data. This documentation process applies both to base data as well as derived data. It is vital that digital map data have external documentation to help in the search and identification of applicable data as well as to help prevent inappropriate applications of the data. In 1989, the Montana GIS Interagency Technical Working Group developed a set of guidelines for documenting GIS data. These guidelines represent an abstract level of information which should be recorded for each GIS data theme. The guidelines are as follows:

5.1 GIS DATA DOCUMENTATION GUIDELINES

■ PROJECT NAME:

[Specify file name/codes/themes if needed to x-ref Primary Index]

■ DATA DESCRIPTION:

Attribute (tabular)/Spatial

Base/Derived Coverage

■ DATA COLLECTED:

Date of Collection [Specify beginning and ending dates]

Methods [Specify or cite reference if commonly available]

Devices [Specify]

QA/QC [Specify or cite reference/standards if commonly available]

■ PROCESSING:

Agency/Source Contact: [Specify: Title, Address, Phone, Fax #]
(if different from Acquisition/Storage on Primary Index)

Date:

Hardware/Software (if different from Storage on Primary index:)

Conversion/Transformation History:

Other/Comments: [Specify any unique information about this data which would assist in evaluating its other potential uses]

Scanner/Manual Digitizer/Camera: [Specify: Device/Resolution/Processing Software (version)/Map Medium/Registration error]

■ SPATIAL ANALYSIS:

(Source/Date if different from above:)

[Specify: Ground Truth/Edge Matching/Other]

Are Agency Standards Available?

■ **ATTRIBUTE OR TABULAR DATA ANALYSIS:**

(Source/Date: if different from above)

[Specify: Models/Statistical Analyses/Other]

[Specify: Extent of Attribute Files]

■ **QUALITY ASSURANCE/QUALITY CONTROL:**

Have data undergone QA/QC?

Do data meet Montana data standards? (Chapter 3)

Are other internal QA/QC documents and/or standards available?

The Natural Resource Information System used these guidelines to develop a GIS data inventory survey for Montana. This survey led to the creation of the *Montana Data Directory* -- an inventory of GIS applicable data in Montana.

5.2 MONTANA DATA DIRECTORY

The *Montana Data Directory* is an inventory of GIS data sources designed to **minimize duplication and promote sharing of digital data** among the various agencies and organizations using GIS within the state. The *Directory* will be updated semi-annually by the Natural Resource Information System. The NRIS manages the *Montana Data Directory* on behalf of the Montana Interagency GIS Technical Working Group and the Montana GIS User Group.

5.2.1 Montana Data Directory Records

There are three types of records included in the *Directory*.

- Data Source Records: Records of the **data sources**, providing full details on the theme, areal extent of the data, quality, cost, access, status, etc., of each source.
- People/Organization Records: Records of the **people/organizations** that manage or are responsible for the data sources, including names, addresses, phone numbers; this sub-division is referred to as Users.
- Project Records: Records of the **projects** ongoing in Montana that have or will generate digital spatial data, including project titles, objectives, status, start/end dates, computer parameters (i.e. GIS use), and general description of study areas; this sub-division is referred to as Projects.

At the request of the Montana Interagency GIS Technical Working Group, two fields have been added to the *Data Directory* data source records. The first is a field to identify whether a data layer meets the standards as described in Chapter 4. The second field will identify whether a particular layer is endorsed by the TWG as the accepted state-wide base layer.

5.2.2 Input to the *Montana Data Directory*

The Natural Resource Information System will take the responsibility for maintaining and updating the *Data Directory*. NRIS will develop the necessary input programs and enter the information into the database. Participating organizations can help NRIS in this task by:

- filling out data survey forms and supplying them to NRIS or
- if an inventory of GIS data already exists in a computer database, those files can be transferred directly into the *Directory*. Please call NRIS at (406) 444-5354 to work out the exact details.

CHAPTER 6 -- STATE-WIDE BASE LAYERS

- 6 A key to successful state-wide GIS database formation is the development of base layers. The digital base layers for Montana are identified below. In addition, the role of the TWG in the evaluation and endorsement of base layers is described.

6.1 BASE LAYERS

The TWG will list agencies currently creating and maintaining base GIS layers. The digital data layers will reside with the agency responsible for the data collection and maintenance. In those cases where there is no appropriate agency to house the data, the layers may be stored at the Natural Resource Information System. As stated in Chapter 3, the preferable state-wide scale is 1:100,000. The state-wide GIS base layers are:

- Transportation
- Utilities
- Topography
- Hydrography
- US Public Land Survey
- Geographic Names
- Boundaries
- Administrative
- Generalized Ownership (includes private)
- Census Geography
- Soils
- Land Use
- Vegetation
- Geology

6.2 ASSESSMENT OF BASE DATA LAYERS

The GIS Interagency TWG will maintain a permanent meeting agenda item for the identification and review of base data layers. The TWG will apply the data standards as described in Chapter 3 of the plan to assess whether a layer meets the standard. Additionally, the TWG will identify the best source available for each of the base layers listed above (Section 6.1) and any future identified layers. Before endorsement of a base data layer, the TWG will fully identify the specific subcategories of each major base layer. Before endorsement of a base data layer, the TWG will fully identify the specific subcategories and attributes for each of each base data layer. Subcategories will be identified by point, line, and polygon needs. Identification of layers and a determination of standards application will be added to the Data Directory. A data layer may be endorsed as an accepted base layer even if it does not meet the standards as described in Chapter 3 if the TWG determines it is the best available layer. The goal is that all base layers for the state will meet standards.

Status of the creation and availability of base layers will be published in the *Montana GIS News* on a regular basis. Information regarding the layer name, scale, agency, availability status, and whether the layer meets the standards outlined in Chapter 3 will be listed in a table in the newsletter.

CHAPTER 7 -- ETHICAL CONSIDERATIONS

- 7 Use of automated geographic information system technology is a relatively new and rapidly expanding technology. both new and established GIS users need to recognize ethical concerns and issues related to the use of the technology, sharing of data and resources, and servicing a wide user community. In an effort to address these issues, the TWG has prepared some guidance related to both agency and individual GIS ethical responsibilities. According to the code of Ethics of the American Society of Photogrammetry and Remote Sensing (ASPRS), the principles on which ethics are founded consist of honesty, justice and courtesy.

The TWG encourages participating GIS users groups to actively apply specific agency policies on data acquisition, analyses, validation, and sharing to individual GIS systems to the broadest extent possible. The TWG encourages government agencies to strive to balance data exchange through GIS with specific agency guidance on protection of confidential data.

In addition, the TWG encourages GIS professionals to provide the highest standards through appropriate, usefully organized, and well documented data and skillful, accurate, and unbiased analyses.

APPENDIX A: Memorandum of Understanding

MEMORANDUM OF UNDERSTANDING

among

U.S. Department of Interior -- Bureau of Land Management;
Fish and Wildlife Service/Charles Russell Wildlife Refuge;
Geological Survey; Bureau of Indian Affairs;
Bureau of Mines/Western Field Operations;
U.S. Department of Agriculture -- Forest Service/Region 1;
Soil Conservation Service/Montana State Office;
U.S. Environmental Protection Agency/Region VIII, Montana Office;
U.S. Department of Energy -- Bonneville Power Administration;
Western Area Power Administration
State of Montana -- Department of Fish, Wildlife & Parks;
State Library/Natural Resource Information System;
Montana State University; University of Montana;
Department of Natural Resources and Conservation;
Reserved Water Rights Compact Commission;
Department of State Lands; Department of Transportation;
Bureau of Mines and Geology; and others

concerning:

Interagency Coordination and Support for Geographic Information Systems (GIS) in Montana.

1. PURPOSE

This Memorandum of Understanding (MOU) documents an agreement to establish a vehicle for participating agencies and organizations to coordinate the development of geographic information systems (GIS) in Montana. The MOU encourages agencies to minimize the duplication of digital data, transfer technology and exchange data, develop data standards, and share resources in completing joint, interagency projects.

II. OBJECTIVES

The parties of this MOU share the following objectives:

- A. To establish a cooperative effort to share digital data among the various resource management agencies and organizations within the state.

- B. To make available all relevant, public domain, digitized databases managed by participating agencies.
- C. To develop priorities for joint GIS development efforts and projects.
- D. To investigate opportunities to jointly fund projects designed to create statewide, base map themes for Montana.
- E. To develop and share new and emerging technologies to facilitate GIS products.
- F. To promote the use of GIS by resource managers, scientists, educators, and where appropriate, the general public.

III. AUTHORITIES

The participating agencies and organizations enter this agreement under the general authority of their administrative rules as a commitment to efficiency of information processing. This MOU supersedes the general provisions of the Montana Interagency Information Processing Coordinating Group and its GIS Subcommittee, established in 1985 and disbanded in 1989.

IV. PROCEDURES

- A. A Montana GIS Interagency Management Steering Committee shall be formed, consisting of one management representative from each agency or organization which signs as a party to this MOU. The first chairperson shall be selected by the committee members to serve a term of one year; subsequent chairpersons will serve in the order that signatures appear on this MOU.
 - 1. The purpose of the Steering Committee will be to develop the Committee charter and an action plan to meet the objectives of this MOU, and to provide necessary direction to the Technical Working Group provided for in SECTION IV.B. below. The Steering Committee will identify potential interagency projects, determine long-term direction and operational parameters, and direct the implementation of action items.
 - 2. The Steering Committee will meet at least annually, in conjunction with an annual statewide GIS User Group conference or at some other, mutually convenient time. Steering Committee meetings will be arranged by the chairperson.
- B. A Montana GIS Interagency Technical Working Group shall be formed, consisting of appropriate representatives from each participating agency. The Technical Working Group shall meet four times per year and at other times, based on need. The purpose

of the Technical Working Group will be to carry out necessary technical functions as directed by the Steering Committee. Such functions may include:

1. Coordinating inventories of digital data in Montana, such as maintained by the Natural Resource Information System at the State Library.
2. Creating a data documentation format to provide standard information about the data contents of a given GIS project.
3. Developing and compiling data standards for the common base map themes depicting public land lines, hydrography, transportation, and ownership.
4. Investigating methods and priorities towards the creation of a statewide transferable digital database.
5. Coordinating GIS research and development activities.
6. Preparing information for publication and dissemination to the GIS User Group, and the general public as needed; also making presentations and offering GIS-related workshops at an annual GIS User conference.

V. GENERAL PROVISIONS

- A. Term of Agreement. This MOU will remain in effect until amended or canceled.
- B. Periodic Review. The participants will review this MOU at least every five years to assess its adequacy, effectiveness, and continuing need.
- C. Amendments. Any participant may propose changes to this MOU during its term. Any change will be in the form of an amendment and will not take effect until all participants have agreed to and signed the amendment.
- D. Cancellation. This MOU may be canceled at any time during its term, by mutual agreement among the participants, or by any participant giving the other participants at least 30 days notice.
- E. Adding Participants. New participants may be added if:
 1. Such new participants agree to all portions of this agreement, and
 2. All existing signatories agree to the addition of new signatories.

APPENDIX B: United States National Map Accuracy Standards

United States National Map Accuracy Standards

With a view to the utmost economy and expedition in producing maps which fulfill not only the broad needs for standard or principal maps, but also the reasonable particular needs of individual agencies, standards of accuracy for published maps are defined as follows:

1. **Horizontal accuracy.** For maps on publication scales larger than 1:20,000, not more than 10 percent of the points tested shall be in error by more than 1/30 inch, measured on the publication scale; for maps on publication scales of 1:20,000 or smaller, 1/50 inch. These limits of accuracy shall apply in all cases to positions of well-defined points only. Well-defined points are those that are easily visible or recoverable on the ground, such as the following: monuments or markers, such as bench marks, property boundary monuments; intersections of roads, railroads, etc.; corners of large buildings or structures (or center points of small buildings); etc. In general what is well defined will also be determined by what is plottable on the scale of the map within 1/100 inch. Thus while the intersection of two road or property lines meeting at right angles would come within a sensible interpretation, identification of the intersection of such lines meeting at an acute angle would obviously not be practicable within 1/100 inch. Similarly, features not identifiable upon the ground within close limits are not to be considered as test points within the limits quoted, even though their positions may be scaled closely upon the map. In this class would come timber lines, soil boundaries, etc.
2. **Vertical accuracy**, as applied to contour maps on all publication scales, shall be such that not more than 10 percent of the elevations tested shall be in error more than one-half the contour interval. In checking elevations taken from the map, the apparent vertical error may be decreased by assuming a horizontal displacement within the permissible horizontal error for a map of that scale.
3. **The accuracy of any map may be tested** by comparing the positions of points whose locations of elevations are shown upon it with corresponding positions as determined by surveys of a higher accuracy. Tests shall be made by the producing agency, which shall also determine which of its maps are to be tested, and the extent of such testing.
4. **Published maps meeting these accuracy requirements** shall note this fact on their legends, as follows: "This map complies with National Map Accuracy Standards."
5. **Published maps whose errors exceed those aforesaid** shall omit from their legends all mention of standard accuracy.
6. **When a published map is a considerable enlargement** of a map drawing (manuscript) or of a published map, that fact shall be stated in the legend. For example, "This map is an enlargement of a 1:20,000-scale map drawing", or "This map is an enlargement of a 1:24,000-scale published map."
7. **To facilitate ready interchange and use of basic information for map construction** among all Federal mapmaking agencies, manuscript maps and published maps, wherever economically feasible and consistent with the uses to which the map is to be put, shall conform to latitude and longitude boundaries, being 15 minutes of latitude and longitude, or 7.5 minutes, or 3-3/4 minutes in size.

*Issued June 10, 1941
Revised April 26, 1943
Revised June 17, 1947*

U.S. Bureau of the Budget

APPENDIX C: Data Format Conversion Matrix

TO:	ARC/INFO	Autocad	DLG	ERDAS	GRASS	INTERGRAPH	MOSS	PAMAP	TIGER
FROM:									
ARC/INFO	X	DXF	X	X	DLG	DXF	X	DLG	X
Autocad	DXF	X				DXF		DXF	
DLG	X		X		X		X	X	
ERDAS	X			X					
GRASS	DLG	DXF	X		X	DXF	F	DLG	
INTERGRAPH	DXF	DXF			DXF F	X		X	
MOSS	X		X		F		X	DLG	
PAMAP	DLG	DXF	X		DLG	X	DLG	X	
TIGER	X				X			DLG	X

X = Indicates a direct software transfer/conversion routine exists.

F = Indicates intermediate formatting required

Disclaimer

Any mention or use of trade names, computer hardware, computer software, or commercial products does not constitute recommendation for use or endorsement.

APPENDIX D: Montana Data Directory
Data Sources Input Form

Theme: _____

Abstract: _____

Coverage: _____

Data Fields: _____

Keywords: _____

Can a user access the data:

Through your agency? Full Access Limited Access No Access Varies Unknown

Through NRIS? Full Access Limited Access No Access Varies Unknown

Through a modem? Full Access Limited Access No Access Varies Unknown

If through a modem enter the phone number: (_____) _____ - _____

Availability: Confidential Private Public Not Available Unknown Varies

Cost: _____

Data Quality: Excellent Good Fair Poor Unknown Varies

Status: Completed Incomplete Under Development Planned Not Available Unknown Varies

Update Frequency: Annual Semi-Annual Frequent Sporadic Not Updated Unknown Varies

Project Title (if any): _____

Entered or Reviewed by: _____ Date: ____/____/____

Comments

Access: _____

Data Quality: _____

General: _____

Data Formats

Type	Description	Media/Software-Hardware	Hardcopy?	Digital?
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____

(Types: **D** = Tabular Database, **M** = Map, **I** = Image, **T** = Text, **U** = Unknown)

Comments: _____

Collection Activity

Agency	Begin Date	End Date	Comment
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

GIS Specific Data

Scale: **1:** _____ Resolution: _____

Projection: _____

Coordinate System Units: Decimal Degrees Degrees Feet Inches Meters TRS Unknown

Feature Type(s): _____

Attribute Documentation: Excellent Good Fair Poor Varies Unknown

Attribute Accuracy: Excellent Good Fair Poor Varies Unknown

Coordinate Documentation: Excellent Good Fair Poor Varies Unknown

Coordinate Accuracy: Excellent Good Fair Poor Varies Unknown

User Documentation

Description	Type	Quality
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

(Types: **M** = Manual, **O** = Online, **B** = Manual & Online, **T** = Tutorial, **U** = Unknown)

(Quality Codes: **E** = Excellent, **G** = Good, **F** = Fair, **P** = Poor, **V** = Varies, **U** = Unknown)

Comments: _____

**Montana Data Directory
Data Sources Input Form
Counties and Coordinates**

Circle one or more counties:

Beaverhead	Flathead	McCone	Roosevelt
Big Horn	Gallatin	Meagher	Rosebud
Blaine	Garfield	Mineral	Sanders
Broadwater	Glacier	Missoula	Sheridan
Carbon	Golden Valley	Mussellshell	Silver Bow
Carter	Granite	Park	Stillwater
Cascade	Hill	Petroleum	Sweetgrass
Chouteau	Jefferson	Phillips	Teton
Custer	Judith Basin	Pondera	Toole
Daniels	Lake	Powder River	Treasure
Dawson	Lewis & Clark	Powell	Valley
Deer Lodge	Liberty	Prairie	Wheatland
Fallon	Lincoln	Ravalli	Wibaux
Fergus	Madison	Richland	Yellowstone

Enter the degrees/seconds/minutes for all of the polygons that describe your data:

Polygon No.	Latitude	Longitude	Polygon No.	Latitude	Longitude
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____

Montana Data Directory
User Input Form

Name: _____

Organization: _____

Department: _____

Address: _____

City/State/Zip: _____

Phone: (____) _____ - _____ Ext: _____

FTS: (____) _____ - _____ Ext: _____

Montana Data Directory
Project Input Form

Title: _____

Purpose: _____

Area Covered: _____

Start Date: ___/___/_____ End Date: ___/___/_____

Status: ___ Complete ___ On-Going ___ Planned

Is new data generated by the project? ___

Does the project use GIS? ___

Software and Hardware used by the project: _____

Additional comments about the project: _____
